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THE BOTANICAL CHARACTERS
OF SOME CALIFORNIAN SPECIES
OF
GRINDELIA

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In a paper presented to this Association last year by F. B. Power and F. Tutin, on the "Chemical Examination of Grindelia,"* the authors stated that the material employed by them, having been obtained "directly from California," "was evidently *Grindelia robusta*, one of the varieties of the latter, or a closely related species. The material in question was, in fact, found to conform most closely in its characters to the description of *Grindelia camporum*, Greene."

In a discussion which followed the reading of the paper it was remarked by one of the speakers (Professor Rusby) that the authors had failed "to state the exact species of the grindelia used, and that in California one would meet *Grindelia robusta* or *Grindelia squarrosa*, and more likely the latter" (*loc. cit.*, p. 201).

Since the presentation of the above-mentioned paper, I have had an opportunity of submitting a sample of the material used by Power and Tutin to Dr. Willis L. Jepson, author of the "Flora of Western Middle California," and he states that the plant is undoubtedly *G. camporum* as defined by him in the aforesaid work. With regard to Professor Rusby's statement, the fact may be noted that *Grindelia squarrosa*, Dunal (*Donia squarrosa*, Pursh) can hardly be said to occur in California at all. Its distribution is given by Gray in the "Synoptical Flora of North America" (Vol. I, Part II, p. 118) as "Plains and prairies, Minnesota and Saskatchewan to Montana and south to Missouri and Texas, west to Nevada, Arizona, and borders of California (Mex.)," and by Britton and Brown in their "Illustrated Flora of the Northern States and Canada" (Vol. III, p. 321) as "In dry soil, Illinois and Minnesota to Manitoba, south to Missouri, Texas, Nevada and Mexico. Adventive in southern New Jersey." *Grindelia squarrosa*, Dunal, is not mentioned in the "Botany of California," and I, myself, have not seen any undoubted specimen of this species from California, either at the British Museum or at Kew. Dr. Jepson, who has made a life-long study of the Flora of California, also informs me that he has never found it in that State.

The *Grindelia camporum* of Greene, as extended by Jepson in the "Flora of Western Middle California," is the common "gum plant" of California, and I am told by Dr. Jepson that the frequency of its occurrence

* Proc. A. Ph. A., 1905, 53, p. 193.

as compared with that of the next most abundant species, viz., *Grindelia cuneifolia*, Nuttall, is at least as a thousand to one.

Both *G. cuneifolia* and *G. camporum* are now generally acknowledged by Californian botanists to be species distinct from *G. robusta*, Nuttall, and they have even been resolved into further species by Professor E. L. Greene; but in the "Botany of California" (vol. i, p. 304), they were considered as varieties of *G. robusta*, the variety *angustifolia* corresponding to *G. cuneifolia*, Nuttall, and the var. (?) *rigida*, corresponding in part, at least, to *G. camporum*. In the "Synoptical Flora," *l. c.*, p. 119, *G. cuneifolia* is again recognized as a distinct species, but the var. *rigida* is merged into *G. robusta*.

Grindelia robusta, as represented by Nuttall's type specimen in the British Museum, is a somewhat rare plant, varieties of it only being recorded in Jepson's "Flora of Western Middle California." As this plant does not appear to have been figured before, I append a sketch which I have drawn myself from Nuttall's type-specimen (see Fig. 1). Nuttall's description is as follows:

"*Grindelia robusta*; herbaceous, smooth; leaves cordate-oblong, obtuse, amplexicaule, coarsely serrate, scabrous on the margin, the upper ones acute, nearly entire; capituli corymbose, involucrum squarrose and leafy at base; receptaculum paleaceous near the margin, pappus of two setæ.

"HAB. St. Pedro, Upper California. Flowering in April. A very stout and robust species, about eighteen inches high, apparently biennial, very smooth; leaves about an inch broad, an inch and a half long. Rays forty to fifty, flowers very large, more than twice the size of those of *G. squarrosa*, which this species much resembles, but the leaves are broadest at the base. Stigma hirsute, pointed, but little exserted."* (Trans. Am. Phil. Soc. N. S. vii (1841), p. 314.)

This plant occurs much too sparingly to be a factor of any importance in the consideration of the drug on the market, but the closely-related *G. camporum* is collected in large quantities. *G. camporum* occurs abundantly in the inner coast ranges, where it has been collected in quantity on the borders of Lake and Napa counties. It is also common in the foot-hills of the Sierra Nevada, and is almost the only plant found on the plains in certain regions of the Sacramento Valley. Curiously enough, although this species is the most frequently collected for the drug market, it is but scantily represented in public herbaria.

The feature which enables one to distinguish *G. camporum* from *G. squarrosa* is found in the ripe akenes. This had already been indicated by Asa Gray in the "Botany of California" (Vol. I., p. 303), where it is stated that the western species of *Grindelia* are all different from the eastern, and that "some good characters may be furnished by the ripe akenes,

* The leaves of the specimen are darkish-green, but the stem is pale. The akenes are not sufficiently mature to possess their characteristic features.—P. E. F. P.

which are known in few species." In the "Synoptical Flora" *G. squarrosa* is placed in the group in which the akenes have no terminal border, and *G. robusta* and *G. cuneifolia* in the one in which all or some of the outer akenes are 1-2 dentate or auriculate-bordered at the summit; the "akenes (at least outer ones)," in *G. robusta*, are stated to be "obliquely auriculate or broadly unidentate at summit," and the "outer akenes," in *G. squarrosa*, "commonly (but not always) corky-thickened and with broad truncate summit, those toward the centre narrower and thinner-walled and with smaller areola." The accuracy of these observations appears to be fully borne out by the material which I have examined. The akenes of the disk in *G. camporum* and *G. cuneifolia* are compressed, and in *G. camporum* they are usually biauriculate (see Fig. 2), or, more rarely, unidentate at the summit, as indicated by Professor Greene in his "Manual of the Botany of the Region of San Francisco Bay" (p. 171); those of *G. squarrosa* are four-angled, and without the distinct auriculate appendages of *G. camporum* (see Figs. 3 and 3A which were drawn by me from one of Drummond's specimens). The conical-urceolate shape of the heads of *G. squarrosa*, which is stated in the U. S. P. to differentiate that species from *G. robusta* (in which the heads are described as depressed-urceolate), does not seem to be a character of much value, judging by the specimens which I have examined; the photographs of undoubtedly authentic *G. squarrosa* reproduced on Plate II. will show that the heads of this species may be very depressed indeed. The evidence afforded by the vegetative characters of such polymorphous species as *G. squarrosa* and most of the western species is also of uncertain diagnostic value, but the upper leaves of *G. camporum* are usually broader relatively to their length than those of *G. squarrosa* (compare Figs. 4 and 4A, which represent average shapes in the former, with Figs. 5 and 5A, which represent the predominating shapes in *G. squarrosa*.) The foliage of *G. camporum* is also usually paler than in *G. squarrosa*, and the leaves are more rigid in the former, as stated under *G. robusta* in the "Synoptical Flora," *l. c.*, p. 119.

A possible reason of confusion in connection with the drug of commerce may have arisen from the fact that the terms "Grindelia squarrosa" and "Grindelia robusta" have been loosely applied to the drug by dealers.

I was, for instance, informed by a San Francisco dealer that when eastern drug houses required "Grindelia squarrosa" and "Grindelia robusta" to be separately provided, the plant growing in the marshes (*G. cuneifolia*, and its variety *paludosa*) was supplied for "Grindelia robusta," while *G. camporum*, the plant of the dry hills and plains, was supplied for "Grindelia squarrosa." These designations are, to some extent, justified by the facts, inasmuch as *G. cuneifolia*, var. *paludosa*, Jepson, is the largest of all the Grindelias, attaining a height, according to Jepson, of five feet in the Suisun marshes, and hence deserving of the name "*robustissima*," while *G. camporum* is probably as squarrose as any of the Grindelias.

It is interesting to record that Nuttall's type-specimen of *G. cuneifolia* is also in the British Museum. I have accordingly sketched this also (see Fig. 6), as the subject may be of interest to the members of the American Pharmaceutical Association, as well as to botanists generally. Nuttall, from the incompleteness of his specimen, marked his species as dubious, but it has been reinstated by subsequent botanists. Nuttall's description is as follows:—

"*Grindelia cuneifolia*; smooth, leaves entire (?) cuneate-oblong, obtuse or linear-oblong, acute, amplexicaule; capitulum sessile, somewhat glutinous, squarrose; stigmas very long, acute, pubescent."

"HAB. St. Barbara, Upper California. Of this I have seen only two small branches, the lower leaves may be different. The capitulum like that of *G. glutinosa*, of which it is, perhaps, a variety. The stigmas very long and exserted. Leaves pellucidly punctate. Pappus of five or more setæ." (Trans. Am. Phil. Soc. N. S. vii (1841), p. 315.)

G. cuneifolia and its variety *paludosa* are marsh plants. They are not as glutinous as *G. camporum*, and the leaves in addition to their tendency to assume the cuneiform shape, from which the specific name is derived, are darker green than in *G. camporum*, and not so thick; the characters of the akenes are similar.

A portion of a large field at Dartford, Kent, England, was planted with young seedlings of *G. cuneifolia*, and the remainder with seedlings of *G. squarrosa*. These had been raised from authentic "seeds" in each case, the akenes of *G. squarrosa* having been specially procured for us from the vicinity of Manhattan, Kansas, and those of *G. cuneifolia* through the kindness of Professor Willis L. Jepson, of the University of California. The behavior of these two species was consistently and markedly different. The Californian plants all sent up stems in the first year, which flowered sparingly during that year, but abundantly in the next; no radical leaves were produced. The plants of *G. squarrosa*, without exception (and there were some thousands of them), produced a tuft of radical leaves in the first year, but no stems; in the second year they sent up stems bearing innumerable heads, in contrast with the more sparingly flowered *G. cuneifolia*. The tint of the foliage of *G. squarrosa* was decidedly glaucous, that of *G. cuneifolia* a pure green. Further experiments on these lines would doubtless reveal further points of difference between other species of *grindelia*, and we hope to make experiments in this direction with *G. camporum*.

The constituents of the plants cultivated in England were found by Dr. Power to differ materially from those of the official drug, but owing to the absence of well-defined active constituents in the latter, no exact comparison between the two was possible. It should be added, in conclusion, that the only *Grindelia* I have seen on the London market during the last two years is *Grindelia camporum*, and this condition also apparently ob-

tains in the United States, for Professor John Uri Lloyd states that there is no *G. squarrosa* on the general market (Pharm. Review, Milwaukee, Nov. 1905, p. 329).

EXPLANATION OF FIGURES.

Plate I.

- Fig. 1. Nuttall's type of *Grindelia robusta*, $\frac{2}{3}$ linear.
- Fig. 1A. Disk floret of same, $\frac{2}{3}$ linear.
- Fig. 2. Akene of disk of *G. camporum*. *a*, auriculate appendages, $\frac{2}{3}$ linear.
- Fig. 2A. "Obscurely triquetrous" akene of ray of *G. camporum*, $\frac{2}{3}$ linear.
- Figs. 3 and 3A. Akenes of *G. squarrosa*, $\frac{2}{3}$ linear.
- Figs. 4 and 4A. Leaves from upper portion of stem of *G. camporum*, $\frac{2}{3}$ linear.
- Figs. 5 and 5A. Leaves from upper portion of stem of *G. squarrosa*, $\frac{2}{3}$ linear.
- Fig. 6. Nuttall's type of *G. cuneifolia*, $\frac{2}{3}$ linear.

Plate II.

Photographs of specimens of *G. squarrosa*, grown at Dartford, Kent, England.
Reduced.





